NORTHERN ILLINOIS UNIVERSITY

The Role of Executive Functions in Facilitating Soothing Behavior During Interactions with a Simulated Distressed Infant

A Thesis Submitted to the

University Honors Program

In Partial Fulfillment of the

Requirements of the Baccalaureate Degree

With Upper Division Honors

Department Of

Psychology

By

Katie M. Laws

DeKalb, Illinois

May 14, 2011

University Honors Program

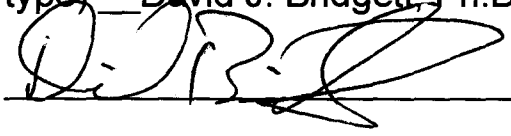
Capstone Approval Page

Capstone Title (print or type)

The Role of Executive Functions in Facilitating Soothing Behavior During Interactions with a Simulated Distressed Infant

Student Name (print or type) Katie M. Laws

Faculty Supervisor (print or type) David J. Bridgett, Ph.D.

Faculty Approval Signature 

Department of (print or type) Psychology

Date of Approval (print or type) 4/26/11

HONORS THESIS ABSTRACT
THESIS SUBMISSION FORM

AUTHOR: Katie M. Laws

THESIS TITLE: The Role of Executive Functions in Facilitating Soothing Behavior During Interactions with a Simulated Distressed Infant

ADVISOR: David J. Bridgett, Ph.D.

ADVISOR'S DEPARTMENT: Psychology

DISCIPLINE: Psychology

YEAR: 2011

PAGE LENGTH: 26 pages

BIBLIOGRAPHY: included in paper

ILLUSTRATED: n/a

PUBLISHED (YES OR NO): No

LIST PUBLICATION: n/a

COPIES AVAILABLE (HARD COPY, MICROFILM, DISKETTE): Hard Copy

ABSTRACT (100-200 WORDS): included in hard copy of paper

The Role of Executive Functions in Facilitating Soothing Behavior During Interactions with a Simulated Distressed Infant

Katie M. Laws

Northern Illinois University

Abstract

Prior work has noted the importance of parenting for supporting the development of emotion regulation in infants/children. The goal of this study was to examine the influence of adult EF on behavioral responses to infant distress. The current investigation used a novel methodological approach, the infant simulator paradigm (ISIM), to evaluate the effects of participant EF on soothing behavior during interactions with an inconsolable, simulated infant. Given the importance of EF in regulation of behavior, it was predicted that participants with lower EF would engage in fewer soothing behaviors (i.e., sensitive vocalizations, soothing touch, distracting, and caretaking efforts) than participants with higher EF. Non-parent college students participated in a laboratory interaction with the ISIM. Participants also completed the Wisconsin Card Sorting Task, and two Stroop-like tasks which assessed aspects of EF. Following a demonstration, participants interacted with the inconsolable ISIM. Interactions were video/audio recorded and later coded for targeted soothing behaviors. Kappa's for each behavioral code ranged from .70 to .92 (M = .78). Regression analyses controlling for gender and prior caregiving experience indicated that greater EF difficulties predicted less frequent use of soothing vocalizations. A trend in the expected direction was also found such that greater difficulties with inhibitory control were associated with fewer distraction attempts. The findings have implications for intervention work such that the efficacy of parenting interventions may be enhanced by considering caregiver EF, as those with EF difficulties may need more intensive, practice oriented interventions.

Keywords: Executive functions, soothing behavior

Previous research has noted the importance of early parenting in supporting the development of self- and emotion-regulation in young children (Purdie, Carroll, & Roche, 2004). For example, studies have shown that characteristics such as parenting style, parent self-efficacy, and psychological disorders (e.g. depression) influence various aspects of children's and adolescent's development (Rhoades, Leve, Harold, Neiderhiser, Shaw & Reiss, 2011; Rohrer, Cicchetti, Rogosch, Toth, & Maughan, 2011; Thirlwall & Creswell, 2010). In particular, recent evidence suggests that parenting practices are important for the development self-regulation (Maughan, Cicchetti, Toth, & Rogosch, 2007; Purdie, Carroll, & Roche, 2004; Treyvaud, et. al., 2009). Self-regulation can be defined as a multifaceted process in which individuals utilize cognitive functions including goal setting, self-monitoring of behaviors, and motivation beliefs (Schmitz & Wiese, 2006; Zimmerman, 2000). Although some studies are beginning to examine how parents own self-regulation influences parenting behavior and children's self-regulation, few studies have examined how specific aspects of adult self-regulation, such as executive functions, influence specific parenting behaviors. The goal of the current study is to extend existing work by linking specific executive functions with specific parenting behaviors that are used to soothe infants when infants are distressed.

Parenting behaviors have been implicated as a key component of child development. Prior investigations have noted that these behaviors are contributors to children's developing abilities of self-regulation, emotion-regulation, including the development of executive functions. Executive functions (EF) can be defined as a set of cognitive processes including goal-oriented behavior, cognitive flexibility, decision making, set shifting, and inhibitory control (Friedman, Miyake, Young, DeFries, Corley, & Hewitt, 2008; Gohari & MacDonald, 2009; McCabe, Roediger, McDaniel, Balota, & Hambrick, 2010). This is important, as for example,

research has shown that children with poor EF are at a greater risk for behavior issues such as hyperactivity, attention problems, disinhibition behaviors, emotional problems (Espy, Sheffield, Wiebe, Clark, Moehr, 2011). Bernier, Carlson, & Whipple (2010) investigated the quality of parent-infant interactions and subsequent child EF characteristics. These researchers measured working memory, impulse control, and set shifting in children at ages 18 and 26 months using various versions of the Stroop task which measures inhibitory control. Maternal sensitivity, mind-mindedness, and autonomy support were measured in the mothers when the children were 12 and 15 months old. These investigators found that both maternal sensitivity and autonomy support are related to the development of children's EF (Bernier, Carlson, & Whipple, 2010). Another study found that different parenting styles across various cultures are related to the development of young children's self-regulation and self-recognition. Children who experience a distal parenting style develop self-recognition earlier than those who experience a proximal parenting style or a mixture of both (Keller, Yovsi, Borke, Kartner, Jensen & Papaligoura, 2004). A third study examined three dimensions of parenting style including autonomy support, involvement, and provision of structure and aspects of children's self-regulation and competence. The findings found that parental autonomy support was positively related to children's self-reports of autonomous self-regulation and maternal involvement was related to achievement (Grolnick & Ryan, 1989). Finally, Kochanska, Murry & Harlan (2000) found that maternal responsiveness at 22 months of age contributed to infant's effortful control 11 months later. These prior investigations confirm that parenting characteristics are critical for supporting the development of children's self-regulation. However, it should be noted that these parenting characteristics are not the only factors that influence the development of children. It is possible that specific parenting behaviors also are important to children's development

Previous research has noted the importance of specific parenting behaviors that may influence the development of infants and children. These behaviors include vocalizations, caregiving effort, distraction attempts, and soothing touches. For example, research has found that the way in which a mother speaks to her infant influences the development of that infant. Early dialogue between parents and their children is an important factor for the acquisition of culture for the child. (Keller, Otto, Lamm, Yovsi, & Kärtner, 2008). Keller and Schölmerich (1987) found that parental verbalizations made up of almost half of all parental reactions to infant vocalizations. Another study looked at the impact of adult vocalizations in response to infant distress during immunizations. Nonprocedural talk to an infant had strong beneficial effects for the distress of the infant (Blount, Devine, Cheng, Simons, & Hauitin, 2008). Also, the use of other parenting behaviors such as distracting and touch (i.e. use of a pacifier, playing with an object, and physical comfort) were also beneficial (Blount, Devine, Cheng, Simons, & Hauitin, 2008). Specific parenting behaviors can be pinpointed and have been shown to affect children's development. These behaviors also have an influence on the more immediate behaviors of infants. A concept that previous bodies of literature are lacking, however, are what factors influence the type and frequency of specific behaviors that parents exhibit towards their children.

Thus far, the literature has focused almost exclusively on social and emotional characteristics of parents (e.g., Belsky, 1984) and often times environmental factors (e.g., McLyod, 1998). A possible cognitive component that may influence the parenting practices adults use during interactions with their children may in fact be the executive function abilities of parents. Parenting practices draw upon a variety of cognitive abilities (i.e. planning, problem solving, flexibility and attention). Research has largely overlooked the importance of parents'

cognitive abilities in relation to parenting practices. Since EF are used in daily activities by parents, it is possible that these cognitive functions also play a role in the type and quality of interactions parents have with their children and infants. Some aspects of EF that may be critical to parenting include working memory, inhibitory control, and cognitive flexibility. For example, one study found that working memory in mothers did have an influence on mothers' parenting behaviors. Mothers with poorer working memory displayed more reactive negativity when interacting with their children (Deater-Deckard, Sewell, Petrill, & Thompson, 2010). This is an important study because it begins to look at parental cognitive function as it relates to parenting behavior. Another study looked at the links between maternal and paternal attention-deficit/hyperactivity disorder (ADHD; a disorder that commonly is associated with EF difficulties) symptoms and parenting practices that require the use of EF including: inhabitation of impulses, attention, and consistency. They found that a mother's ADHD symptoms were positively associated with inconsistent discipline and non-supportive responses to their child's negative emotions (Mokrova, O'Brien, Calkins, Keane, 2010). Similarly, higher levels of father's ADHD symptoms predicted more inconsistent discipline, and mediated the link between parental ADHD and parental involvement in the child's life. (Mokrova, O'Brien, Calkins, Keane, 2010). In sum, only a few previous studies have noted that parents who have difficulties with EF tend to react more negativity to their children, be inconsistent, and less supportive (Chen & Johnson, 2007). Even still, the current body of research has not fully examined adult cognitive functions. For example, the current literature has failed to examine fully the possibility that adult EF skills may play a significant role in the frequency and type of parenting behaviors parents engage in when interacting with their infant or child. While previous investigations have noted connections between EF and parenting behaviors in older children, only one study has examined

connections between maternal self-regulation and parenting of infants. One aspect of self-regulation is effortful control, which is the ability to anticipate, detect errors, and activitate a subdominant response in place of a more dominant response (Rothbart & Bates, 2006). In this study, effortful control predicted the amount of time mothers spent in various interactive caregiving activities with infants. It was found that greater maternal time spent in interactive caregiving with infants contributed to higher toddler effortful control after controlling for maternal effortful control (Bridgett, et al., 2010). Based on these studies, an important individual difference aspect of parents that appears to support parenting behaviors is adult EF.

Although some preliminary work has been done that supports the importance of parental EF for parenting behavior, no studies, so far, have evaluated the effects of EF on parenting behavior in the context of stressful parenting situations, such as situations in which infants/young children become inconsolably upset. It is important to determine the factors that influence parenting behaviors, especially less effective or negative parenting behaviors. Since EF characteristics have been shown to influence an individual's behavior, it is possible that EF characteristics play an important role in the frequency and type parenting behaviors exhibited by parents.

The current study is designed to help fill in the gap of literature and expand knowledge of adult cognitive functions as they relate to facilitating soothing caregiving behaviors that parents often exhibit. The primary goal of the study was to examine the role of adult EF and specific behavioral responses to persistently high levels of infant distress using a novel parenting simulation task. Currently, there is no systematic way of investigating the reactions people have to high levels of infant distress. A simulated infant was used during a novel parenting simulation task in order to mimic real life situations in which infants have a lot of trouble calming down.

The current study is a pilot study that used college students as participants. The pilot study examined the role of college student EF on specific behavioral responses to persistently high levels of infant distress. It was hypothesized that when attempting to soothe an inconsolable simulated infant, participants who exhibited greater difficulties with executive functions (i.e., poor inhibitory control and cognitive inflexibility) would engage in less frequent sensitive vocalizations, less frequent caretaking efforts, lest frequent attempts at distraction, less frequent attempts at distraction, and less frequent use of soothing touch.

Method

Participants.

Participants (n = 77) were recruited from the Psychology 102 subject pool to participate in a larger study examining the influence of various adult individual difference characteristics (e.g. temperament and emotion regulation) on responses to infant distress cues. Given the limited number of participants who were parents, data collected from student parents were excluded from all analyses. All participants in the study were 18 years of age or older. Participant ages included 18 at 18 years of age (23.4%), 35 at 19 years of age (45.5%), 13 participants at 20 years of age (16.9%), 4 participants at 21 years of age (5.2%), and 9 participants between the ages of 22 and 25 (9.1%). The sample in the study included 50 females (65%) and 27 males (35%). There were 45 Caucasians (59.7%), 17 African Americans (22.1%), 9 Hispanic/Latino (11.7%), 2 Asian (2%), and 1 Native American (1%) included in the study. Twenty-two percent of the participants had no prior caregiving experience with infants, while 78.9% said they had at least some experience caring for an infant. As compensation for their participation, students earned course credit and were entered into a drawing for a chance to win $75, which took place at the end of each semester during with data collection occurred.

Measures.

Participant Gender.

Participant gender was coded based on one question included on the demographic form. Males were given a score of 1. Females were given a score of 2. These values were used in calculations for the participant gender in all subsequent analyses.

Previous Caregiving Experience.

Previous caregiving experience (PCE) was measured by one question included in the demographic form. PCE was assessed by asking participants to indicate the number of infant-related experiences (e.g. feeding, bathing, changing, playing, soothing/consoling) they had prior to participation in the study. The range of possible scores for this variable was 0 to 6 with higher scores indicating more extensive experience with infants prior to participation in the study.

Executive Function.

Participants completed the computerized version of the Wisconsin Card Sorting Task (WCST; Psychological Assessment Resources, 2003). The WCST is a task that is considered to measure flexible thinking, which is an aspect of EF. Cognitive inflexibility was assessed by averaging and standardizing the number of errors (preservative and non-preservative) each participant incurred on the WCST. Participants also completed two conditions of a Stroop-like task to measure inhibitory control. These conditions included the Inhibition and Inhibition Switching trials of the Color-Word Interference task from the Delis-Kaplin Executive Function System (D-KEFS; Pearson, 2001). Inhibitory control was calculated as a mean of the standardized values of the number of errors made and completion time during the Inhibition and Inhibition Switching trials of the D-KEFS.

Procedure.

Participants attended a laboratory session that lasted approximately three hours. During this session participants completed a variety of self-report questionnaires and participated in several interactive tasks, including the EF tasks described above. The last task participants completed was the Infant Simulator Paradigm (ISIM), which developed to measure a variety of responses to high levels of infant distress.

The ISIM task utilized a simulated infant to assess participants' responses to infant distress. The ISIM is a life-like and sized doll representative of a newborn 4-month-old Hispanic infant, which appears to be neutral in gender. The gender of the simulated infant was counterbalanced within participant gender. The female simulated infant, Kathryn, was dressed in pink clothing, while the male simulated infant, Sam, was dressed in blue clothing.

Prior to the task, participants were given a description of the ISIM and a research assistant (RA) following a standard script, described that when distressed, the ISIM could be calmed using voice, facial expressions, touches and handling. During the demonstration, the ISIM was programmed so that it needed to be fed. The RA demonstrated that the simulator could be soothed, and engaged in behaviors that can be used to soothe an infant, such as talking, smiling, touching, rocking, and feeding the ISIM over the course of 2-3 minutes. Because the RA wears a "caregiver microchip" on his/her wrist under an Ace bandage, the simulated infant calmed down once the microchip was recognized and the bottle was touched to its mouth. After the demonstration, the RA strapped the ISIM into a highchair in the middle of the room and informed the participant that it is now his/her turn with the ISIM. Each participant was told that he/she should feel free to move about the room and use any of the toys or props during his/her interaction with the ISIM as he/she sees fit. The toys and props available to the participant during the task included a changing table, highchair, rocking chair, stuffed owl, stuffed dog,

stuffed bear, a book, rubber duck, a ball, a rattle, toy keys, a bottle, a diaper, a mirror, three large plush blocks, and three gender specific blankets. While the participant's remaining questions were being addressed, a second RA located in the control room, reprogrammed the ISIM to be inconsolable. During the participant's interaction with the ISIM, the ISIM became increasingly upset over 225s cry cycles. Participants interacted with the ISIM for up to 6 full cry cycles, unless they requested to discontinue the task earlier. Participants were told prior to beginning the task, that they are able end the task at any time. Because each participant will not be provided with a "caregiver microchip" during his/her interactions with the ISIM, the simulated infant did not recognize the participant as a caregiver and did not calm down until after the computer software was manually stopped by the second RA.

After the participant completed the ISIM task, they were debriefed. As part of the debriefing, participants were informed that the simulator was programmed such that it was impossible for them to soothe, and that their behavior and/or inability to soothe the simulator was not a reflection on their child-caring skills. Consistent with the standard IRB protocol, each participant was provided with a list of local resources, such as counseling services, that could be accessed should they feel it necessary. Before leaving, all remaining participant questions were answered, he/she signed a debriefing form, and completed a short questionnaire concerning the ISIM task.

Behavioral Coding.

Targeted participant behaviors were continuously coded by RAs trained to a Kappa reliability of .80 or higher using Noldus 10.0 software. The targeted behaviors included vocalizations, caretaking, distracting, and touch. Ten percent of all coded ISIM interactions were coded by a second coder to establish the inter-rater reliability of each code. Vocalizations

that were coded included talking or singing, shushing, or other soothing sounds made towards the ISIM (k = .74). Coded caretaking behaviors consisted of efforts to feed, change, or wrap the ISIM in a blanket (k = .77). Distracting behaviors that were accounted for included the use of an auditory toy (e.g., a rattle), a quiet toy (e.g., a stuffed animal), a mirror, or a book (k = .92). Coded soothing touch behaviors included patting, rubbing, or stroking, holding/playing with the ISIM's hands or feet, and tickling (k = .70). The rate per minute at which participants engaged in these behaviors was be calculated and utilized in all further analyses.

Results

Descriptive statistics are shown in Table 1. Participants spent an average of 17.27 minutes with the simulated infant. Participants also used soothing vocalizations toward the ISIM on average of 5.05 times per minute (SD = 2.81). Caretaking efforts were used by participants on average of .535 times per minute (SD = .025), and distracting efforts were utilized on average .568 times per minute (SD = .054). Participants engaged in touch behaviors during interactions with the ISIM, on average, 1.38 times per minute (SD = .775).

Cognitive inflexibility was calculated by averaging the number of perseverative and non-perseverative errors made during the WCST. On average, participants made 7.99 perseverative errors (SD = 5.09) and 7.25 non-perseverative errors (SD = 5.97) during the WCST. Inhibitory control was calculated by averaging the number of errors made on the Inhibition and Inhibition Switching trials of the DKEFS. During the Inhibition trial of the DKEFS, participants made an average of 2.03 errors (SD = 2.53) and completed the task in an average of 47.54 seconds (SD = 11.56). During the Inhibition Switching trial of the DKEFS, participants averaged 2.32 errors (SD = 2.49) and completed the task in an average of 55.42 seconds (SD = 12.11).

Pearson-correlations were run to examine the relationship between all variables (i.e. cognitive inflexibility, inhibitory control, participant gender, PCE, and the rate per minute at which participants engaged in the target behaviors; See Table 2). Participant gender was significantly positively related to PCE ($r = .47, p < .01$) such that females had more previous caregiving experience than males. Participant gender was also positively correlated with inhibitory control ($r = .29, p <. 05$), meaning females had poorer inhibitory control than males. Participant gender was also positively correlated with the rate per minute in which participants engaged in touch behaviors with the ISIM ($r = .37\, p < .01$). Participant PCE had significant positive association with inhibitory control ($r = .26, p < .05$) and participant touch rate per minute ($r = .36, p < .01$). There was a significant negative correlation between PCE and participants' distracting rate per minute ($r = -.31, p < .01$). Cognitive inflexibility was negatively associated with rate per minute of vocalizing behavior ($r = -.32, p < .01$), participants who were more cognitively inflexible used fewer vocalizations per minute. Also, cognitive inflexibility was positively correlated with rate per minute of caretaking behavior ($r = .27, p < .05$). Inhibitory control was negatively correlated with both participant vocalizing rate per minute ($r = -.27, p < .05$) and participant distracting rate per minute ($r = -.24, p < .05$), such that participants who had more difficulties with inhibitory control used fewer vocalizations and distracting behaviors per minute. Participant vocalizing rate per minute was positively correlated with participant touch rate per minute ($r = .30, p< .01$), and participant distracting efforts per minute was negatively correlated with participant touch rate per minute ($r = -.38, p < .01$).

A series of four hierarchical multiple regressions were conducted to examine the effect of cognitive inflexibility and inhibitory control on the rate per minute at which participants used the target behaviors (i.e. vocalizations, caretaking, distracting, and touch) in their interactions with

the ISIM. The hierarchical multiple regression that was conducted to examine the rate per minute at which participants utilized soothing vocalizations in their interactions with a simulated, distressed infant found that participant gender ($\beta = .963, p > .05$) and previous caregiving experience ($\beta = -.125, p > .05$) did not account for a significant portion of the variance in vocalizing RPM ($\Delta R^2 = .022, p > .05$). However, in support of the hypotheses, cognitive inflexibility ($\beta = -.851, p < .05$) and inhibitory control ($\beta = -1.010, p < .05$) did account for a significant portion of the variance in vocalizing RPM ($\Delta R^2 = .143, p < .01$).

To examine the effect of cognitive inflexibility and inhibitory control on the rate per minute at which participants utilized caretaking behaviors during their interactions with the ISIM, the hierarchical multiple regression found that participant gender ($\beta = .007, p > .05$) and previous caregiving experience ($\beta = .000, p > .05$) did not account for a significant portion of the variance in the rate per minute at which participants utilized caretaking behaviors ($\Delta R^2 = .028, p > .05$). Similarly, cognitive inflexibility ($\beta = .006, p > .05$) and inhibitory control ($\beta = -.001, p > .05$) also did not account for a significant portion of the variance in caretaking RPM ($\Delta R^2 = .065, p > .05$).

Another hierarchical multiple regression was conducted to examine the effect of cognitive inflexibility and inhibitory control on the distracting rate per minute at which participants engaged in the behavior found that participant gender ($\beta = .002, p > .05$) did not account for a significant portion of the variance, however, previous caregiving experience ($\beta = -.007, p < .05$) did account for some of the variance in participants distracting rate per minute RPM ($\Delta R^2 = .099, p < .05$). There was a trend in the anticipated direction such that inhibitory control ($\beta = .011, p < .10$) and cognitive inflexibility ($\beta = -.015, p < .10$) accounted for participants distracting rate per minute ($\Delta R^2 = .069, p < .10$).

The hierarchical multiple regression that was conducted to examine the effect of participant touch rate per minute during interactions with the ISIM found that participant gender ($\beta = .421, p < .05$) did account for a significant portion of the variance. Previous caregiving experience ($\beta = .076, p < .10$) had a trend in the expected direction. Overall, participant gender and PCE did account for a significant amount of variance in the rate per minute of touch behaviors participants engaged in ($\Delta R^2 = .183, p < .001$). Interestingly, cognitive inflexibility ($\beta = -.083, p > .05$) and inhibitory control ($\beta = .087, p > .05$) did not account for a significant portion in the variance in touch rate per minute ($\Delta R^2 = .016, p < .087$). Test statistics and standardized regression coefficients are shown for all regressions in Table 3.

Discussion

Consistent with prior work, the current study found that EF effects on parenting behavior were demonstrated using a novel and stressful simulated parenting task. It was hypothesized that while attempting to sooth an inconsolable simulated infant, participants who exhibited greater EF difficulties such has poor inhibitory control and cognitive inflexibility would use fewer sensitive vocalizations per minute, fewer caretaking efforts per minute, fewer attempts at distraction per minute, and less frequent use of soothing touch behaviors per minute than those participants who had less EF difficulties.

It was found that participants who exhibited difficulties with cognitive flexibility and inhibitory control actually did engage in fewer soothing vocalizations as a technique to calm the simulated infant during the ISIM task. This finding illustrates the possibility that parents with EF difficulties may vocalize less towards their infants when their infant is in an extremely distressed state. Also, a trend was observed such that participants who had greater difficulties

with inhibitory control used fewer distractions attempts per minute when interacting with the distressed ISIM. Specifically, participants who had trouble inhibiting their actions on the Inhibition and Inhibition Switching trials of the D-KEFS also attempted to distract the ISIM less often than those who had fewer difficulties with the inhibitory control. These results highlight the importance of EF in facilitating soothing vocalizations and distracting behaviors during interactions with the ISIM. However, it should be noted that for caretaking efforts per minute and touch behaviors per minute, no significant results were found. This indicates that not all parenting behaviors may be influenced by difficulties with cognitive inflexibility and inhibitory control. Other factors may be influence the type and rate per minute at which individuals engage in various soothing behaviors. These factors may be other characteristics of the caregiver (i.e. personality or IQ), or knowledge the caregiver has about interacting effectively with a distressed infant.

The findings in the current study are consistent with previous research. Overall, it was found that adult EF is important for interactions in the context of high infant distress. Blount, et. al. (2008) found that adults who used nonprocedural talk had significant beneficial effects on the level of the infant's distress and distracting attempts was approaching the significant level in relation to beneficial effects for the infant. The finding that greater difficulties with EF contributed to fewer soothing vocalizations per minute shows how this particular parenting behavior can be important with actual parents in real life situations (i.e. during immunizations) during which infants may become highly distressed. Similarly, the trend such that difficulties with inhibitory control were associated with fewer distraction attempts per minute is also important to note in relation to Blount, et. al (2008). Distracting infants while they are in high levels of distress may be beneficial to the infant and parents with difficulties in inhibitory control

may not use this behavior as frequently as parents with fewer difficulties with inhibitory control. This means that the infants of parents with inhibitory control difficulties may not be receiving the most efficient care from their parents because they are not using beneficial behaviors as frequently as might be necessary to help infants soothe and develop their own self-regulatory skills. Previous studies have found that maternal inattention and lower working memory have been associated with less child involvement and inconsistent disciplinary practices in older children (Mokrova, O'Brien, Calkins, Keane, 2010; Chen & Johnson, 2007), and only one study has examined the associates between maternal self-regulation and caregiving activities with infants (Bridgett, et al., 2010). This is the first study to demonstrate the importance of adult EF for interactions with infants in the context of high infant distress and to demonstrate the importance of specific adult EFs for specific, fine-grained aspects of parenting behavior. Inevitably infants will become distressed for a number of reasons (i.e. illness, immunizations, hunger, and pain), and caregivers need to be able to appropriately soothe the infant. The ISIM task was developed to see how participants interact with a distressed infant in a controlled, standardized and simulated laboratory situation, and to look at the behaviors that participants used while also assessing their cognitive abilities.

Implications.

The findings of this study may have implications for intervention work. For example, considering caregiver EF when assessing the difficulties that parents face both internally and externally may enhance the efficacy of parenting interventions. Caregivers with EF difficulties may need more intensive and practice-oriented interventions that directly address EF difficulties. This will help to ensure that caregivers will be able to learn and effectively use strategies that will help them meet their infants' needs. Caregivers will then be able to better interact with a

distressed infant and use soothing caretaking behaviors more frequently and effectively, thereby helping their young child develop and internalizing effect self-soothing strategies.

Limitations.

While the current study makes a few important contributions to research, it is important to also note the limitations of the study. One of the most pressing limitations is the use of non-parents for the study. Many of the conclusions drawn from this study relate to caregiving skills for infants, and none of the participants in the study were parents. This was a conscious decision as the study was being used a pilot study to see if the ISIM paradigm is effective in eliciting soothing behaviors that can be used to calm a simulated distressed infant. Another limitation of the study was the first experimenter was in the room during the participants' interactions with the ISIM. This may have caused some participants to be uncomfortable because they were being closely watched and may not have interacted as they normally would or for the same length of time if they were interacting without the experimenter in the room. That is, the demand characteristics of the experimenter being in the room may have altered participant behavior. Another limitation is in the demographic form, participants are asked about their previous caregiving experience, however, participants are not asked about their knowledge of infant care. This may be an important piece missing from this study. Simply having caregiving experience does not mean that the individual has appropriate knowledge of how to care for an infant. In addition to the limitations noted above, it may be beneficial to look at measures that look at different aspects of EF, such as verbal fluency tasks and/or participant self-reported EF, which will broaden the ability of future work to identify other EFs that may influence parenting behaviors. Finally, the behavioral coding was done at the rate per minute at which participants engaged in a variety of caregiving behaviors may be a limitation. This type of coding is limiting

to the study because even though it does give an accurate depiction of what behaviors were used and how frequently they were utilized, this coding scheme does not look at the quality of behavior. Future studies may look at coding the quality of the interaction participants had with the ISIM, or even transcribing the sessions to see what exactly participants said during the task.

Future Studies.

Future studies should further examine the importance of adult EF for interactions with a highly distressed infant. They should consider using other measures of different aspects of EF to see if other cognitive processes are also important for interactions with a distressed infant. Future studies should also use real caregivers who are currently taking care of an infant. These studies should continue to use the ISIM to see if the findings are similar to the findings of the current study that uses non-parent participants. Given the links between EF and parenting behavior and the importance of parenting for children's developing regulation, future studies should also consider the examination of the possibility that parenting mediates associations between caregiver EF and children's developing self-regulation.

References

Belsky, J. (1984). The determinants of parenting: A process model. *Child Development, 55* 83-96.

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children's executive function functioning. *Child Development, 81*, 326-339.

Blount, R. L., Devine, K. A., Cheng, P. S., Simons, L. A., & Hayutin, L. (2008). The impact of adult behaviors and vocalizations on infant distress during immunizations. *Journal of Pediatric Psychology, 33,* 1163-1174.

Bridgett, D. J., et al. Emerging effortful control in toddlerhood: The role of infant orienting/regulation, maternal effortful control, and maternal time spent in caregiving activities. *Infant Behavior and Development* (2010). doi: 10.1016/j.infbeh.2010.12.008

Chen, M., & Johnston, C. (2007). Maternal inattention and impulsivity and parenting behaviors. Journal of Clinical Child and Adolescent Psychology, 36(3), 445-468.

Computerized Wisconsin Card Sort Task Version 4 (WCST). Psychological Assessment Resources; 2003.

Deater-Deckard, K., Sewell, M. D., Petrill, S. A., & Thompson, L. A. (2010). Maternal working memory and reactive negativity in parenting. *Psychological Science, 21i,* 75-79. doi: 10.1177/0956797609354073

Delis-Kaplan Executive Function System (D-KEFS). Pearson; 2001.

Espy, K. A., Sheffield, T. D., Wiebe, S. A., Clark, C. A. C., & Moehr, M. J. (2011). Executive control and dimensions of problem behaviors in preschool children. *Journal of Child Psychology and Psychiatry, 52:1*, 33-46. doi: 10.1111/j.1469-7610.2010.02265.x

Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P., & Hewitt, J. K. (2008). Individual differences in executive functions are almost entirely genetic in origin. *Journal of Experimental Psychology: General, 137(2)*, 201-225. doi:10.1037/00963445.137.2.201

Gohari, V. M., & MacDonald III, A. W. (2009). The neural basis of cognitive control: Response selection and inhibition. *Brain and Cognition, 71,* 72-83. doi:10.1016/j.bandc.2009.04.004

Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology, 81*, 143-154.

Keller, H., Otto, H., Lamm, B., Yovsi, R. D., Kärtner, J. (2008). The timing of verbal/vocal communications between mothers and their infants: A longitudinal cross-cultural comparison. *Infant Behavior & Development, 31*, 217-226. doi: 10.1016/j.infben.2007.10.001

Keller, H., & Schölmerich, A. (1987). Infant vocalizations and parental reactions during the first 4 months of life. *Developmental Psychology, 23*, 62-67.

Keller, H., Yovsi, R., Borke, J., Kartner, J., Jensen, H., & Papaligoura, Z. (2004). Developmental consequences of early parenting experiences: Self-recognition and self-regulation in three cultural communities. *Child Development 75*, 1745-1760.

Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood Continuity and change, antecedents, and implications for social development *Developmental Psychology, 36,* 220–232. doi:10.1111/1467-6494.7106008

Maughan, A., Cicchetti, D., Toth, S. L., & Rogosch, F. A. (2007). Early-occuring maternal

depression and maternal negativity in predicting young children's emotion regulation and socioemotional difficulties. *Journal of Abnormal Child Psychology, 35(5)*, 685-703.

McCabe, D. P., Roediger III, H. L., McDaniel, M. A., Balota, D. A., & Hambrick, D. Z. (2010). The relationship between working memory capacity and executive functioning: Evidence for a common executive attention construct. *Neuropsychology, 24(2),* 222-243. doi:10.1037/a0017619

McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. *American Psychologist*, 185-204.

Mokrova, I., O'Brien, M., Calkins, S., & Keane, S. (2010). Parental ADHD symptomology and ineffective parenting: The connecting link of home chaos. *Parenting: Science and Practice, 10*, 119–135.

Noldus Observer XT 10.1. Noldus Information Technology; 2010.

Purdie, N., Carroll, A., & Roche, Lawrence. (2004). Parenting and adolescent self-regulation *Journal of Adolescence, 27(6)*, 663-676.

Rhoades, K. A., Leve, L. D., Harold, G. T., Neiderhiser, J. M., Shaw, D. S., & Reiss, D. (2011). Longitudinal pathways from marital hostility to child anger during toddlerhood: susceptibility and indirect effects via harsh parenting. *Journal of Family Psychology 25(2)*, 282-291. doi: 10.1037/a0022886

Rohrer, L. M., Cicchetti, D., Rogosch, F. A., Toth, S. L., & Maughan, A. (2011). Effects of maternal negativity and of early and recent recurrent depressive disorder on children's false belief understanding. *Developmental Psychology, 47*, 170-181. doi: 10/1037/a0021305

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In N. Eisenburg, & W. Damon (Eds.),

Handbook of child psychology, Vol. 3: Social, emotional, and personality development (6th ed., pp. 99-166). New York: Wiley.

Schmitz, B., & Wiese, B. S. (2006) New perspectives for the evaluation of training sessions in self-regulated learning: Time series analyses of diary data. Contemporary Educational Psychology, *31*, 64-96.

Thirlwall, K., & Creswell, C. (2010). The impact of maternal control on children's anxious cognitions, behviours, and affect: An experimental study. *Behaviour Research and Therapy, 48*, 1041-1046. doi: 10.1016/j.brat.2010.05.030

Treyvaud, K., Anderson, V. A., Howard, K., Bear, M. Hunt, R. W., Doyle, L. W., Inder, T. E., Woodward, L., & Anderson, P. J. (2009) Parenting behavior is associated with early neurobehavioral development of very preterm children, *Pediatrics, 123*, 555- 561. doi: 10.1542/peds.2008-0477.

Zimmerman, B. J. (2008). Investigation of self-regulation and motivation: Historical background methodological developments, and future prospects. American Educational Research Journal, *45*, 166-183.

Table 1:

Descriptive Statistics.

	Mean (M)	Standard Deviation (SD)
Vocalizations rate per minute	5.05	2.81
Caretaking rate per minute	.54	.03
Distracting rate per minute	.57	.05
Touch rate per minute	1.38	.78
WCST perseverative error	7.99	5.09
WCST non-perseverative error	7.25	5.97
D-KEFS Inhibition trial error	2.04	2.526
D-KEFS Inhibition trial completion time	47.56	11.56
D-KEFS Inhibition switching trial error	2.33	2.49
D-KEFS Inhibition switching trial completion time	55.43	11.56

Table 2:

Associations between Measures and Participant Behaviors During Interactions with the Infant Simulator

	1	2	3	4	5	6	7	8
1. Participant Gender	1							
2. PCE	.47**	1						
3. Cognitive Flexibility	.13	.01	1					
4. Inhibitory Control	.29*	.26*	.17	1				
5. Vocalizations	.10	-.02	-.32**	-.27*	1			
6. Caretaking behaviors	.16	.12	.27*	.05	-.03	1		
7. Distracting behaviors	-.13	-.31**	.17	-.24*	.17	.16	1	
8. Touch behaviors	.37**	.36**	-.06	.20	.29*	-.07	-.38**	1

PCE = previous caregiving experience

*$p < .05$, **$p < .01$

Table 3:

Hierarchical Multiple Regression Analyses Predicting Soothing Behavior from Executive Function Measures

Dependent Variable	Predictor	ΔR^2	β
Vocalizations rate per minute			
	Step 1		
	Gender	.022	.963
	Previous Caregiving Experience		-.125
	Step 2		
	Cognitive Inflexibility	.143**	-.851*
	Inhibitory Control		-1.010*
Caretaking rate per minute			
	Step 1		
	Gender	.028	.007
	Previous Caregiving Experience		.000
	Step 2		
	Cognitive Inflexibility	.065	.006
	Inhibitory Control		-.001
Distracting rate per minute			
	Step 1		
	Gender	.099*	.002
	Previous Caregiving Experience		-.007*
	Step 2		
	Cognitive Inflexibility	.069+	.011+
	Inhibitory Control		-.015+
Touch rate per minute			
	Step 1		
	Gender	.183***	.421*
	Previous Caregiving Experience		.076+
	Step 2		
	Cognitive Inflexibility	.016	-.083
	Inhibitory Control		.087

$^{+}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$